IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Siegfried Ruthardt et al

Based on PCT/DE 01/01406

For: Common Rail Injector

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination, please amend the above-identified application as follows:

IN THE SPECIFICATION

Page 1, between the title and paragraph [0001], insert the following:

[0000.2] CROSS-REFERENCE TO RELATED APPLICATIONS

[0000.4] This application is a 35 USC 371 application of PCT/DE 01/01406 filed on April 10, 2001.

[0000.6] BACKGROUND OF THE INVENTION

replace paragraph [0001] with the following amended paragraph:

[0001] Field of the Invention

after paragraph [0002], insert the following new paragraph:

[0002.5] Description of the Prior Art

Page 2, replace paragraph [0007] with the following amended paragraph:

[0007] SUMMARY OF THE INVENTION

Page 3, replace paragraph [0009] with the following amended paragraph:

[0009] A particular embodiment of the invention is characterized in that the support device is formed by an annular support disk, in particular comprising a metal material. The inner circumference of the support disk, in the installed state, rests on the valve element and closes the gap between the valve element and the injector housing.

replace paragraph [0010] with the following amended paragraph:

[0010] A further particular embodiment of the invention is characterized in that the support disk is embodied as slightly conical on its inner circumference. By its conical embodiment, the support disk is given a spring action, which has proved advantageous at extreme pressures, especially upon load changes. Upon an axial pressure stress, the support disk stretches elastically in the radial direction and tightly closes the gap between the valve element and the injector housing.

replace paragraph [0011] with the following amended paragraph:

[0011] A further particular embodiment of the invention is characterized in that the slightly conically embodied inner circumference of the support disk narrows toward the sealing element or away from the sealing element. In practice it has been found that the advantageous effects of the support disk of the invention occur not only when the inner circumference of the support disk tapers toward the sealing element but also if the inner circumference of the support disk tapers away from the

sealing element. This aspect of the invention could not have been expected, without recognition of the significance of the spring action of the support disk.

Page 4, replace paragraph [0012] with the following amended paragraph:

[0012] A further particular embodiment of the invention is characterized in that the support disk is embodied slightly conically on its inner and outer circumference. By the embodiment of the support disk as a double cone in cross section, the support disk is given a stronger spring action. The double cone can be mounted with its tip pointing toward or away from the sealing element.

replace paragraph [0013] with the following amended paragraph:

[0013] A further particular embodiment of the invention is characterized in that leakage grooves are embodied in the support device. By means of the leakage grooves, an intentional leak between the support device and the injector housing is brought about. As a result, slight leakage flows that pass through the sealing element can be removed. This offers the advantage that a pressure cushion cannot build up between the sealing element and the support device. Such a pressure cushion could in fact cause the sealing element to shift undesirably in the axial direction.

replace paragraph [0014] with the following amended paragraph:

[0014] A further particular embodiment of the invention is characterized in that the leakage grooves are provided on the side of the support device remote from the sealing element. This prevents the sealing element from being pressed into the leakage grooves during operation and thereby closing the leakage grooves.

after paragraph [0014], insert the following new paragraph:

[0014.5] BRIEF DESCRIPTION OF THE DRAWINGS

replace paragraph [0015] with the following amended paragraph:

[0015] Further advantages, characteristics and details of the invention will become apparent from the ensuing description, in which various exemplary embodiments of the invention are described in detail in conjunction with the drawings, in which:

delete paragraphs [0016] and [0017]:

replace paragraph [0018] with the following amended paragraph:

[0018] Fig. 1 is a fragmentary elevation view of a longitudinal section through an injector of the invention, with a built-in support disk;

replace paragraph [0019] with the following amended paragraph:

[0019] Fig. 2 is a plan view of a support disk with leakage grooves;

replace paragraph [0020] with the following amended paragraph:

[0020] Fig. 3 is a sectional view taken along the line III-III in Fig. 2; and

replace paragraph [0021] with the following amended paragraph:

[0021] Fig. 4 is an elevation view taken in the direction of arrow IV in Fig. 2.

Page 6, replace paragraph [0022] with the following amended paragraph:

[0022] DESCRIPTION OF THE PREFERRED EMBODIMENTS

replace paragraph [0023] with the following amended paragraph:

[0023] In Fig. 1, a fragment of an injector of the invention is shown in longitudinal section. A complete longitudinal section through such an injector is shown in Fig. 1 of EP 0 604 915 B1, reference to which may be had for a fuller

illustration of the environment of the invention. The injector serves to inject fuel, which is subjected to high pressure, into the combustion chamber of an internal combustion engine (not shown).

Page 7, replace paragraph [0029] with the following amended paragraph:

[0029] By means of the leakage grooves 8, 9, 10 and 11 made in the underside of the support disk 7, an intentional leak is brought about between the support disk 7 and the injector housing 1. Alternatively, it is also possible to make corresponding leakage grooves in the surface of the injector housing or of the valve element 2 toward the support disk 7. By means of the leakage grooves, it is assured that slight leakage flows, which pass through the soft sealing ring 6, can be removed toward the bottom.

Page 8, insert the following new paragraph:

[0031] The foregoing relates to preferred exemplary embodiment of the invention, it being understood that other variants and embodiments thereof are possible within the spirit and scope of the invention, the latter being defined by the appended claims.

Page 9, delete "Claims" and insert --We Claim--.

IN THE CLAIMS

Please cancel claims 1-7 and add new claims 8-22.

8. A common rail injector for injecting fuel in a common rail injection system of an internal combustion engine, comprising an injector housing (1), which communicates with a central high-pressure reservoir and in which a nozzle needle is axially displaceable in order to adjust the injection as a function of the pressure in a control chamber, and a sealing element (6), which is disposed in an annular chamber (3) that is provided between a valve element (2) and the injector housing (1), and in addition to the sealing element (6), a support device (7) is disposed in the annular chamber (3) between the valve element (2) and the injector housing (1).

9. The common rail injector of claim 8, wherein the support device is formed by an annular support disk (7), in particular comprising a metal material.

10. The common rail injector of claim 9, wherein the support disk (7) is embodied as slightly conical on its inner circumference.

11. The common rail injector of claim 10, wherein the slightly conically embodied inner circumference of the support disk (7) narrows toward the sealing element (6) or away from the sealing element (6).

12. The common rail injector of claim 9, wherein the support disk (7) is embodied slightly conically on its inner and outer circumference.

13. The common rail injector of claim 8, wherein leakage grooves (8, 9, 10, 11) are embodied in the support device (7).

14. The common rail injector of claim 9, wherein leakage grooves (8, 9, 10, 11) are embodied in the support device (7).

15. The common rail injector of claim 10, wherein leakage grooves (8, 9, 10, 11) are embodied in the support device (7).

16. The common rail injector of claim 11, wherein leakage grooves (8, 9, 10, 11) are embodied in the support device (7).

17. The common rail injector of claim 12, wherein leakage grooves (8, 9, 10, 11) are embodied in the support device (7).

18. The common rail injector of claim 13, wherein the leakage grooves (8, 9, 10, 11) are provided on the side of the support device (7) remote from the sealing element (6).

19. The common rail injector of claim 14, wherein the leakage grooves (8, 9, 10, 11) are provided on the side of the support device (7) remote from the sealing element (6).

20. The common rail injector of claim 15, wherein the leakage grooves (8, 9, 10, 11) are provided on the side of the support device (7) remote from the sealing element (6).

21. The common rail injector of claim 16, wherein the leakage grooves (8, 9, 10, 11) are provided on the side of the support device (7) remote from the sealing element (6).

22. The common rail injector of claim 17, wherein the leakage grooves (8, 9, 10, 11) are provided on the side of the support device (7) remote from the sealing element (6).

IN THE ABSTRACT

Please substitute the attached Abstract of the Disclosure for the abstract as originally as filed.

REMARKS

The above amendments are being made to place the application in better condition for examination.

Entry of the amendment is respectfully solicited.

Respectfully submitted,

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Page 11, replace abstract for the following amended abstract:

Abstract of the Disclosure

The invention relates to a common rail injector for injecting fuel in a common rail injection system of an internal combustion engine, having an injector housing, which communicates with a central high-pressure reservoir and in which a nozzle needle is axially displaceable in order to adjust the injection as a function of the pressure in a control chamber, and having a sealing element, which is disposed in an annular chamber that is provided between a valve element and the injector housing. In addition to the sealing element, a support device is disposed in the annular chamber between the valve element and the injector housing.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

Page 1, paragraphs [0000.2] through [0002.5]:

[0000.2] CROSS-REFERENCE TO RELATED APPLICATIONS

[0000.4] This application is a 35 USC 371 application of PCT/DE 01/01406 filed on April 10, 2001.

[0000.6] BACKGROUND OF THE INVENTION

[0001] [Prior Art] Field of the Invention

[0002.5] Description of the Prior Art

Page 2, paragraph [0007]:

[0007] SUMMARY OF THE INVENTION

Page 3, paragraphs [0009] through [0011]:

[0009] A particular [type of] embodiment of the invention is characterized in that the support device is formed by an annular support disk, in particular comprising a metal material. The inner circumference of the support disk, in the installed state, rests on the valve element and closes the gap between the valve element and the injector housing.

[0010] A further particular [type of] embodiment of the invention is characterized in that the support disk is embodied as slightly conical on its inner circumference. By its conical embodiment, the support disk is given a spring action, which has proved advantageous at extreme pressures, especially upon load changes. Upon an axial pressure stress, the support disk stretches elastically in the radial direction and tightly closes the gap between the valve element and the injector housing.

[0011] A further particular [type of] embodiment of the invention is characterized in that the slightly conically embodied inner circumference of the support disk narrows toward the sealing element or away from the sealing element. In practice it has been found that the advantageous effects of the support disk of the invention occur not only when the inner circumference of the support disk tapers toward the sealing element but also if the inner circumference of the support disk tapers away from the sealing element. This aspect of the invention could not have been expected, without recognition of the significance of the spring action of the support disk.

Page 4, paragraphs [0012] through [0014]:

[0012] A further particular [type of] embodiment of the invention is characterized in that the support disk is embodied slightly conically on its inner and outer circumference. By the embodiment of the support disk as a double cone in cross section, the support disk is given a stronger spring action. The double cone can be mounted with its tip pointing toward or away from the sealing element.

[0013] A further particular [type of] embodiment of the invention is characterized in that leakage grooves are embodied in the support device. By means of the leakage grooves, an intentional leak between the support device and the injector housing is brought about. As a result, slight leakage flows that pass through the sealing element can be removed. This offers the advantage that a pressure cushion cannot build up between the sealing element and the support device. Such a pressure cushion could in fact cause the sealing element to shift undesirably in the axial direction.

[0014] A further particular [type of] embodiment of the invention is characterized in that the leakage grooves are provided on the side of the support device remote from the sealing element. This prevents the sealing element from being pressed into the leakage grooves during operation and thereby closing the leakage grooves.

[0014.5] BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Further advantages, characteristics and details of the invention will become apparent from the ensuing description, in which various exemplary embodiments of the invention are described in detail in conjunction with the [drawing. The characteristics recited in the claims and mentioned in the description can each be essential to the invention individually or in arbitrary combination with one another.] drawings, in which:

[0016] [Drawing]

[0017] [Shown in the drawing are:]

[0018] Fig. 1[, the] is a fragmentary elevation view of a longitudinal section through an injector of the invention, with a built-in support disk;

[0019] Fig. 2[,] is a plan view of a support disk with leakage grooves[, in plan view];

[0020] Fig. 3[, the elevation view of a section] is a sectional view taken along the line III-III in Fig. 2; and

[0021] Fig. 4[, the] is an elevation view taken in the direction of arrow IV in Fig. 2.

Page 6, paragraphs [0022] and [0023]:

[0022] [Description of the Exemplary Embodiments] DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0023] In Fig. 1, a fragment of an injector of the invention is shown in longitudinal section. A complete longitudinal section through such an injector is shown in Fig. 1 of EP 0 604 915 B1[.], reference to which may be had for a fuller illustration of the environment of the invention. The injector serves to inject fuel, which is subjected to high pressure, into the combustion chamber of an internal combustion engine (not shown).

Page 7, paragraph [0029]:

[0029] By means of the leakage grooves [7,] 8, 9, 10 and [10] 11 made in the underside of the support disk 7, an intentional leak is brought about between the support disk 7 and the injector housing 1. Alternatively, it is also possible to make corresponding leakage grooves in the surface of the injector housing or of the valve element 2 toward the support disk 7. By means of the leakage grooves, it is assured that slight leakage flows, which pass through the soft sealing ring 6, can be removed toward the bottom.

Page 8, paragraph [0031]:

[0031] The foregoing relates to preferred exemplary embodiment of the invention, it being understood that other variants and embodiments thereof are possible within the spirit and scope of the invention, the latter being defined by the appended claims.

Page 11, abstract of the disclosure:

Abstract <u>of the Disclosure</u>

The invention relates to a common rail injector for injecting fuel in a common rail injection system of an internal combustion engine, having an injector housing [(1)], which communicates with a central high-pressure reservoir and in which a nozzle needle is axially displaceable in order to adjust the injection as a function of the pressure in a control chamber, and having a sealing element [(6)], which is disposed in an annular chamber [(3)] that is provided between a valve element [(2)] and the injector housing [(1)]. [To lengthen the service life, in] <u>In</u> addition to the sealing element [(6)], a support device [(7)] is disposed in the annular chamber [(3)] between the valve element [(2)] and the injector housing [(1)].

[(Fig. 1)]